FEEDBACK TO THE SOIL MONITORING LAW FROM THE EJP SOIL INTERNAL PROJECT "MINOTAUR" ON SOIL BIOLOGICAL INDICATORS

As a premise to this feedback, we would like to underline that we fully support a proposal for a Directive on soils, which has as its objective soil protection and tries to counter the threat of degradation. However, as researchers involved in the EU project entitled "Modelling and mapping soil biodiversity patterns and functions across Europe – MINOTAUR" funded within the EJP Soil programme (https://ejpsoil.eu/soil-research/minotaur), we would like to provide some recommendations for amendments to improve the current version of the Directive. More specifically we have some recommendations with respect to the indicators proposed for the monitoring of soil biodiversity loss (Annex I). Although a final position of the MINOTAUR's consortium is not available yet (the project will conclude by December 2024), a preliminary result of the ongoing discussion on "the best" bioindicators for soil health assessment, derived from the best available data, is available. Considering the urgency for implementation of the EU Soil Monitoring Law, we provide our preliminary recommendations for biological indicators in the table below.

Soil biodiversity is crucial for soil functioning and is threatened by global change and anthropogenic pressures. We believe that the complexity of the interactions occurring among organisms and the soil environment that drive the provision of soil functions and ecosystem services, as well as their spatial-temporal variability, cannot be simplified and comprehensively described by just one selected indicator, as proposed currently by the Directive. Soil basal respiration alone will provide limited capability to assess biological health or soil function and no information at all in terms of biodiversity. Thus, a number of complementary descriptors should be added to assess if a soil is healthy or not.

Whereas the definition of a "minimum set" of biological indicators for the assessment of soil health is desirable, a more flexible and tailored, approach may better address the soil functions and ecosystem services in specific contexts. Thus, in order to select appropriate indicators, and to combine practicability with flexibility of the monitoring initiatives, we recommend a two "tiered system" approach (according to relevant EU funded projects like ENVASSO, EcoFINDERS, SIREN and based on the current implementation of soil biological indicators across EU Member States). With this proposed approach a first set of harmonized indicators is recommended in all cases, covering both functional and structural biodiversity, and for which standard methods are available (Tier I group, see table below). Should Tier I results return a "not healthy" status, Member States may also locally apply other indicators (tier II group), to better identify the problem (soil threats) and/or to inform decision pertaining to land management.

Aspect of soil degradation	**Current directive Soil descriptor (Annex I)**	**Recommendation**
Loss of soil biodiversity	Soil basal respiration (mm^3 O_2 g^{-1} hr^{-1}) in dry soil Member States may also select other optional soil descriptors for biodiversity such as: - metabarcoding of bacteria, fungi, protists and animals; - abundance and diversity of nematodes; - microbial biomass; - abundance and diversity of earthworms (in cropland); - invasive alien species and plant pests	Tier I group: Functional diversity: - Soil basal respiration - microbial biomass; - enzyme activity (fluorogenic substrates); Structural diversity: - metabarcoding of microorganisms (bacteria, fungi); - abundance, diversity and ecological indices of nematodes; - abundance, diversity and ecological indices of microarthropods; - abundance, diversity and ecological indices of earthworms;

		Member States may also select other optional soil descriptors for biodiversity (Tier II group), such as: - Specific groups and functional genes (qPCR) - soil metagenomics for biomarkers of soil health - microbial necromass - Soil fauna activity (i.e. organic matter degradation) - N mineralization - Ecophysiological profile (AWCD) - invasive alien species and plant pests

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Organisation name:
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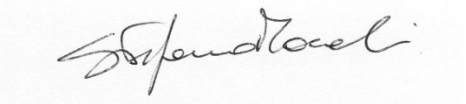
Person signing on behalf of the organisation:
Signature:

Date and place:

Project signature:
Project name: EJP Soil - MINOTAUR
Organisation signing on behalf of the project (coordinator): CREA
Country: Italy
Person signing on behalf of the project: Stefano Mocali (coordinator)
Signature: 

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